

High maternal hemoglobin concentration in first trimester as risk factor for pregnancy induced hypertension

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Abstract

Background: High maternal hemoglobin (Hb) concentration was considered a risk factor for the developing of pregnancy hypertension. The purpose of this study was to determine whether high maternal Hb concentration in first trimesters associated with pregnancy induced hypertension in Iranian nulliparous women.

Methods: This study was carried out in teaching hospital in Sari, Iran. Samples were obtained from 1008 women who were almost on their 14th week pregnancy and were admitted to prenatal clinic of this hospital from October 2008 to December 2009. Their blood pressure was normal. After measuring Hb at first visit, they were divided into groups ($11 \leq \text{Hb} < 13.2$ and $\text{Hb} \geq 13.2$). Pregnancy induced hypertension in these groups were compared.

Results: In normal Hb group, 14(2.75%) women had hypertension and in high Hb group, 21(4.2%) had hypertension ($p=0.045$). High hemoglobin concentration in the first trimester showed a risk factor for pregnancy induced hypertension (OR= 2.462; 95% CI, 1-6.9).

Conclusion: The results showed that women with high hemoglobin concentration in the first trimester carried an increased risk of pregnancy induced hypertension.

Keywords: Hemoglobin Concentration, First trimester, Pregnancy, Hypertension.

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Pregnancy induced hypertension (PIH) is a major cause of maternal mortality and morbidities (1-3). Despite ten years constant effort, we have not exactly found the reason and pathogenesis of PIH yet (1). Much effort has been so far performed to decrease its rate but because of not having correct understanding of PIH pathophysiology, these efforts have not been successful (3). Although the etiology of preeclampsia is unknown, hemodynamic studies suggested that many of the clinical findings might be explained by a generalized vasoconstrictive disorder and abnormal endothelial cell function. Vasoconstriction may be attributed to the increased concentrations of hemoglobin found in preeclampsia compared with normal pregnancy. Free hemoglobin may be derived from hemolytic placental hemorrhage and in concentrations known to be present in preeclampsia. Vasodilatation mediated by endothelium-derived relaxing factor is inhibited. Infusion of oxyhemoglobin into human coronary arteries inhibits acetylcholine-induced vasodilatation. An increased free hemoglobin concentration is the cause of vasoconstriction in preeclampsia (4). In women who have hypertensive disorders of pregnancy, particularly those with preeclampsia, blood volume does not increase, which results in a relatively higher hemoglobin concentration (5). Pritchard et al. showed the average hematocrit for women with preeclampsia which was 0.405, compared with a mean of 0.374 for women with normal pregnancy (6).

Most women with a pregnancy-induced hypertensive disorder are symptomless, which is an important part of the rationale for frequent antenatal visits in pregnancy. Laboratory tests have been used for prediction, diagnosis, and monitoring of the disease progress. The diagnosis of preeclampsia is even based on a laboratory test (7). Some studies have linked high maternal serum hemoglobin levels ($Hb \geq 13.2$) in pregnancy outcomes, such as preeclampsia, preterm birth and small for gestational age (8). Many investigators believe that the conditions for the development of preeclampsia are set as early as the first trimester (9). In one study in primiparous, the frequency of subsequent hypertension ranged from 7% at Hb values under 10.5g/dl to 42% at Hb concentrations over 14.5g/dl (10).

Therefore, we decided to run a study about the relationship between high maternal Hb level in first trimester and the rate of pregnancy induced hypertension.

Methods

All nulliparous pregnant women age 20-34 with alive fetus (between 20-34 weeks) who before reaching their 14th week pregnancy went to the prenatal clinic of the teaching hospital in Sari, Iran. From October 2008 to December 2009, their normal blood pressure was entered into the sampling. They were divided into two groups: ($11 \leq Hb < 13.2$ and $Hb \geq 13.2$). The samples were studied according to the acceptance rate and omission. The sample volume was completed and given by each group.

Women with family history of preeclampsia-eclampsia, had history of systemic diseases like diabetes, critical blood pressure, renal diseases, Those under medication, smokers, had multiple pregnancies, hydrops fetalis, or mole hydatiform, and $BMI \geq 26$, were eliminated from the study. After measuring Hb at first visit, if their Hb was normal, they would be put in the control group and if they had $Hb \geq 13.2$, they would be put in case group. In both groups, the blood pressure was monitored monthly until the 28th week pregnancy, twice a month until the 36th week and finally, weekly until delivery. In every examination their

blood pressure was recorded. In cases that the blood pressure was high or equal to 140/9mmHg, the patients were hospitalized, their blood pressure was controlled and proteinuria for 24 hours.

During the 24 hours monitoring, if the women's blood pressure in 2 occasions between 4-6 hours was at least 140/9mmHg and there was at least 300 mg protein in urine, this would be diagnosed as preeclampsia. The patients were monitored up to 24 hours after delivery and then, eventually were discharged. We took note of the gestational age in the delivery time and way of delivery. After gathering the data, the observed groups were compared regarding PIH. The risk factor for PIH in these two groups ($p < 0.05$) was considered significant.

Results

In women with normal hemoglobin, 512 nulliparous women were enrolled in the study and 505 with high level hemoglobin were entered as well. Four women in normal Hb group and 5 in high level Hb group did not come for delivery and were excluded in this study. The mean age in normal Hb group was 22.31 and in high level Hb group was 21.38 (Table 1). There were 189 cases (37.2%) with cesarean section in normal Hb group and 195 cases (39.00%) in high level Hb group and it was not statistically significant (Table 1). There were 37 cases (7.28%) preterm delivery in normal Hb group and 30 cases (6.00%) in high level Hb group and it was not statistically significant (Table 1).

In normal Hb group, from 508 women monitored 24 hours after delivery, 14 (2.75%) had hypertension and 3 had severe preeclampsia diagnosis. In high level Hb group, from 500 women monitored 24 hours after delivery, 21 (4.20%) had hypertension and 4 had severe preeclampsia diagnosis.

X^2 test showed statistically significant difference in two groups ($p = 0.045$). The risk for developing pregnancy induced hypertension was 2.46 times higher than those with lower hemoglobin concentration. High hemoglobin concentration in first trimester was (OR=2.46, 95% CI: 1-6.1) (Table 1).

Table 1. Pregnancy complications in normal Hb group and high level Hb group.

Level of Hb (g/dl)	number	age(years) mean±SD	preterm labor (N%)	Cesarean (N%)	PIH** (N%)
11≤Hb<13.2	508	22.3±2.1	37(7.28)	189(37.2)	14(2.75)
Hb≥13.2	500	21.38±1.9	30(6)	195(39)	21(4.2)
Pvalue	-	NS	NS	NS	0.045*

*OR2.462 (CI95% 0.995- 6.090)

** Pregnancy Induced Hypertention

Discussion

Our findings show that there was a statistically significant relation between high maternal hemoglobin in the first trimester of pregnancy and preeclampsia. Murphy et al. showed that the levels of hemoglobin in the first and second trimesters were related to adverse pregnancy outcome such as preeclampsia (10). Sarrel et al. suggested that an increased free hemoglobin concentration was the cause of vasoconstriction in preeclampsia (4). Gus Dekker et al. suggested that serial measurements of hemoglobin and hematocrit were used to monitor pregnancies at high risk of uteroplacental insufficiency. Striking increase in concentrations of hemoglobin in the second trimester could predict development of pregnancy-induced hypertensive disorders (11). In preeclampsia, the loss of serum protein and the increase in capillary endothelial permeability led to a decrease in intravascular volume and increased tissue edema (12). All organs could be affected, including the liver, brain, and the lungs. The decrease in blood volume could lead to an increase in maternal hemoglobin concentration (13). Many investigators believed that the conditions in the development of preeclampsia were set as early as the first trimester. (9) Measuring the rate of Hb in the first visit of pregnant women is performed in all cases in routine form. This method could be beneficial for recognizing mothers who were exposed to danger (10).

Consequently, high maternal hemoglobin (Hb≥13.2g/dl) in first trimester is a risk factor for preeclampsia. By considering present and previous studies that have been performed on this subject, high maternal hemoglobin is an independent risk factor for PIH; evaluating main risk factors like: type of nutrition, iron resources,

medicine that causes hemoglobin to increase is necessary. By considering the importance of hygiene promotion, both mother and infant are provided with health protection. We hope the results of this research increase the quality of clinical and educational services for mothers.

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